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Woodward-Clyde Consultants

July 26, 1985
90158A-0002

Mr. Darl Mount
United States Environmental
Protection Agency
Region 6
1201 Elm Street
Dallas, TX 75270

Dear Mr. Mount:

Subject: Transwestern Pipeline Company

As discussed in my letter of May 17, here is a copy of the summary document I promised to send you. This summary contains a description of the general geologic and hydrogeological conditions at each TPC facility in EPA Region 6. Also included in this summary is a discussion of the practices which may have resulted in the presence of PCB's at TPC facilities downstream of Station 8.

Should you have any questions about this material or our activities on behalf of TPC, please contact me or Chris Vais at (415) 945-3000.

Sincerely,

R. W. Castle

R. W. Castle
Project Manager

RWC/sst

Enclosure

0317z

Consulting Engineers, Geologists
and Environmental Scientists

Offices in Other Principal Cities

TRANSWESTERN PIPELINE COMPANY
SUMMARY OF
WASTE LIQUID COLLECTION, STORAGE OR DISPOSAL SITES
AS RELATED TO THE OPERATION OF
COMPRESSOR STATION 8, CORONA, NEW MEXICO
IN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY REGION 6

Introduction

A variety of fluids are generated as a result of the operation of the Transwestern Pipeline Company (TPC) natural gas pipeline. These fluids include pipeline condensate which may have been contaminated by the past use, at Station 8 of compressor oil containing polychlorinated biphenyl (PCB).

TPC is currently implementing a program to assess and remediate the PCB problem and other hazardous waste streams as identified. This report summarizes the work practices resulting in the generation of PCB-contaminated or other potentially hazardous waste liquids at TPC facilities within EPA Region 6 west of and including Compressor Station 8, Corona, New Mexico. Interpretations included in the summary are based on information provided by TPC and on inspection of all facilities described by Woodward-Clyde Consultants (WCC) during the week of April 1, 1985. The report also summarizes available information on the hydrogeology of each site.

Background

The Transwestern Pipeline was constructed in 1959-1960 to deliver natural gas from Roswell, New Mexico to Needles, Arizona for distribution to the California market. It is a 30-inch diameter line, 615 miles in length and includes nine compressor stations, five of which are located in EPA Region 6.

In July, 1968, a synthetic lubricating oil containing PCB's was placed in the gas turbine at Compressor Station 8 (Corona, New Mexico). The PCB-containing lubricating oil remained in the turbine until December 1972, when it was removed because of a notice from the oil manufacturer (The Monsanto Company) that concerns were being expressed about the environmental acceptability of PCB's. During the period of use, PCB's entered the pipeline through seal blowouts from the turbine. Remedial actions to date have included removal and cleaning of the Compressor Station 8 gas turbine, installation of above-ground tanks at all compressor stations and the Rio Grande crossing to collect and store pipeline fluids, and cleanup (excavation and disposal) of waste liquid impoundments at Station 8. Residual PCB's from prior use at Compressor Station 8 are still measurable in liquids removed from the pipeline and in containers used for their storage.

Summary of Practices Which May Have Generated Hazardous Liquids

Fluids routinely accumulate in high pressure natural gas pipelines. These fluids consist primarily of water vapor and natural gas fluids, and may contain trace impurities such as metals and hydrogen sulfide which occur from the source gas fields. No significant amount of such impurities are known to exist in the TPC System. Additional materials may be introduced to the system for cleaning and via compressor blowby, leaky seals, and other causes related to the compressor used to move the gas through the line.

When pipeline fluids accumulate to the point where they interfere with the effectiveness of the system, they are removed by introducing a scraping device called a pig into the line. The pig is pushed through the line by gas pressure and scrapes off material adhering to the sides of the line. It then pushes the accumulated material ahead of it to a collection point known as a pig receiver. Typically, pigs are launched and received between each compressor station with a frequency of one to several times a month. A variety of materials have been introduced into the line intermittently with the pigs in attempts to improve their performance. These materials have included diesel fuel and methanol.

Pipeline fluids are removed at the pig receiver at the time of removal of the pig and placed in a containment for recycling or disposal. Current practice involves collection of pipeline fluids in a concrete containment at the pig receiver. Fluids are then drained to an adjacent concrete or metal sump from which they are pumped to an above-ground holding tank. Pipeline fluids are also accumulated by the gas scrubbers and mist extractor at each station. These devices remove fluids from gases released during pipeline overpressure and during pig removal.

At each pipeline station, small amounts of pipeline fluids may also be produced from pressure relief valves, knockout devices, valve bodies, oriface fittings, meters, piping headers, and other drain points. Typically, these sources of fluid discharge directly to the ground or to the compressor engine room drains.

Waste oil from the compressors and compressor engines, degreasers, detergents, washdown water, and other fluids associated with maintenance and operation of the compressors are collected and drained into a collection sump near the engine house. These sumps pump directly into containments where the floating immiscible materials can be separated and collected.

Most facilities include a machine shop and vehicle maintenance area (wash rack). Materials generated at these locations include small amounts of solvents, degreasers, petroleum lubricants and detergents. On occasion, pigs may have been cleaned at some of the vehicle wash racks. Such actions may have introduced small quantities of PCB's into the respective drains.

TPC facilities in EPA Region 6 which have or are suspected to have PCB contamination include Compressor Station 5 (Thoreau), Compressor Station 6 (Laguna), Compressor Station 7 (Mountainair), and Compressor Station 8 (Corona).

Region 6 Site Descriptions

Compressor Station 5, Thoreau, New Mexico

Pipeline fluids collected from the pig receiver and scrubber were historically placed in an unlined 8'x20'x20' impoundment near the receiver. This impoundment was filled in 1976-78 and was replaced with a 6'x20'x20' concrete-lined impoundment which was used for pipeline fluids until 1983-84. Pipeline fluids from the pig receiver and scrubber are currently stored for periodic off site disposal in an above-ground 500-barrel tank which was installed at the end of 1981. The concrete lined impoundment is currently used only for emergency overflow control for the 500-barrel tank.

Washdown water from the compressor engine room and the maintenance washrack is drained into a concrete-lined 8'x50'x50' impoundment. No direct discharge of pipeline fluids to this impoundment was reported. An additional unlined 6'x26'x56' impoundment is currently used for surface drainage control and overflow from the washrack.

Compressor Station 6, Laguna, New Mexico

Pipeline fluids were stored in a concrete lined 6'x20'x20' impoundment until March/April, 1984. Collected pipeline fluids are now placed in an aboveground 500 barrel tank. The impoundment is currently used for storage of waste oil, washrack discharge and engine room washdown water. Standard practice has included pumping off water from this impoundment to the adjacent land surface. Evidence of surface contamination suggests that some oily material is inadvertantly discharged to the land surface through this process, although no conclusive indication of off site contamination was observed.

A variety of minor leaks and blowdowns were observed in the vicinity of the compressor house.

Compressor Station 7 Mountainair, New Mexico

Pipeline Fluids were originally placed in a 4'x20'x30' unlined impoundment adjacent to the pig receiver. Through August 1984, pipeline fluids were placed in a 5.5'x20'x20' concrete-lined impoundment. A 500-barrel above-ground tank is used to store collected pipeline fluids.

A 6'x40'x40' concrete-lined impoundment is located along the center of the western property boundary. This impoundment is used for waste oil and engine room washdown water. Drainage from the wash rack discharges to an unlined impoundment east of the compressor house. Overflow from this impoundment drains into another unlined impoundment to the south. This impoundment is used primarily for water softener brine.

Compressor Station 8, Corona, New Mexico

Pipeline fluids and engine room washdown water were placed in three unlined impoundments near the pig receiver. Impoundments A (5'x67'x59') and B (5'x50'x54') were used until September 1981. Both of these impoundments were closed and backfilled in October 1983. Impoundment C (4'x50'x40) was operated (presumably for washdown water) until August 1984, when it was closed and backfilled. Pipeline fluids, waste oil and washdown water are currently stored in an above-ground 500-barrel tank.

Rio Grande River Crossing (Belen)

A pig receiver is located on the east side of the Rio Grande River. A concrete-lined, covered impoundment exists at the discharge to the pig receiver. Historically, pipeline fluids were collected and stored in this impoundment. Currently, pipeline fluids are collected in this impoundment and automatically pumped to a 500-barrel, above-ground tank. A mist extractor and blowdown at the site also discharge to the 500-barrel tank.

Estimated Quantities of Waste Liquids Stored on TPC Facilities

Estimation of the quantities of waste liquid stored on TPC facilities in EPA Region 6 at and west of Compressor Station 8 are based on tank and impoundment measurements taken by station personnel on or about April 22, 1985. The calculated volumes of liquids are summarized in Table 1. It should be noted that volumes of fluids will change constantly as additional material is generated and removed for disposal.

Summary of Available Site Hydrogeologic Information

The purpose of this hydrogeologic summary is to individually examine each site to ascertain its general geologic and hydrologic characteristics. This examination utilizes information supplied by TPC and that available from the general literature. The TPC facilities located in EPA Region 6 are shown in Figure 1.

The subject facilities (Figure 1) are located within two distinct physiographic provinces and as such have climatic, geologic, and hydrogeologic conditions unique to each site. Generalized geologic cross sections and depth to groundwater for each station is shown on Figures 2, 3, 4, and 5.

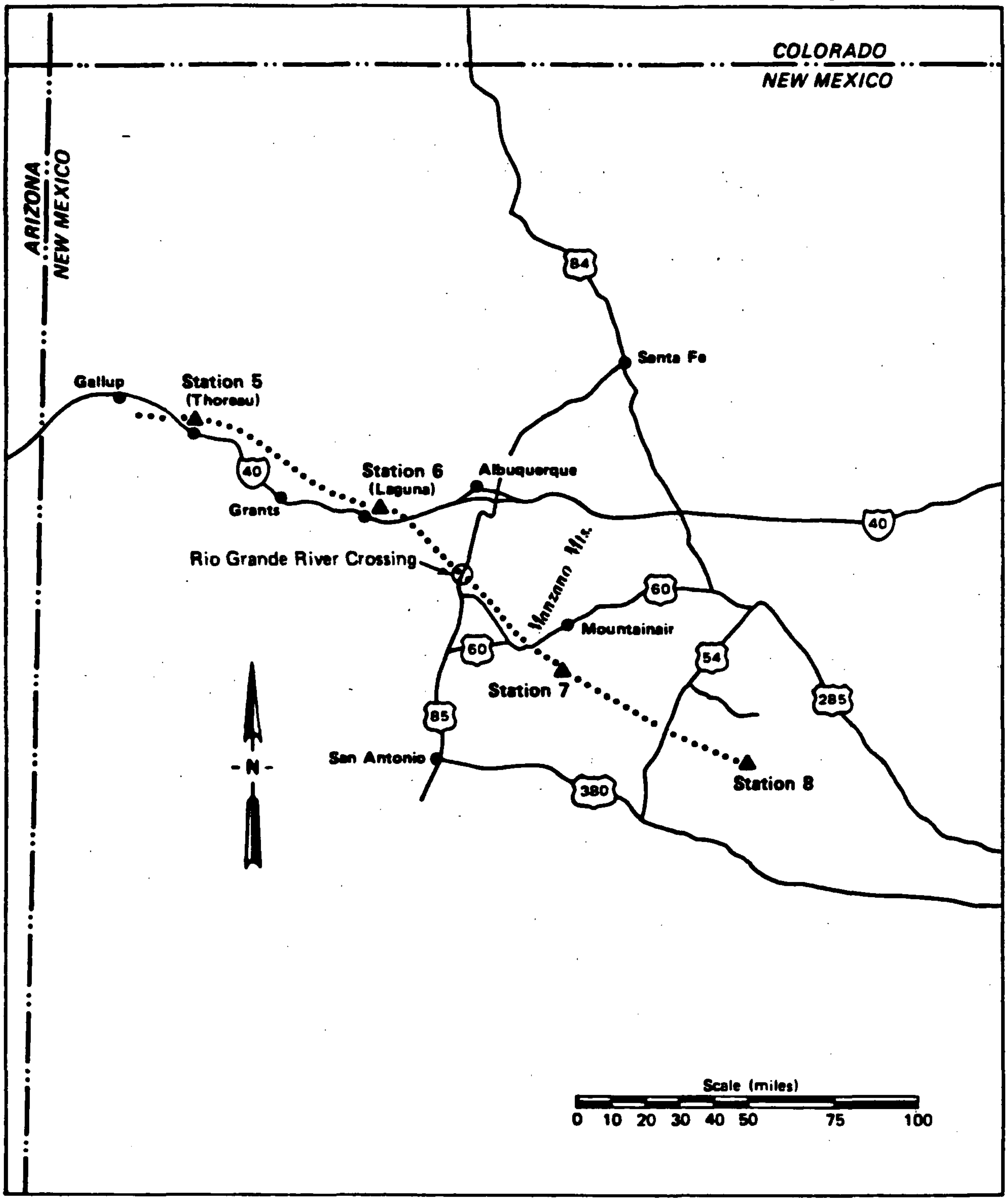
Compressor Station 5, Thoreau

Transwestern Pipeline Compressor Station 5 is located about 1 1/2 miles northwest of Thoreau, McKinley County, western New Mexico (Figure 1). Interstate Highway 40 and the Achison-Topeka-Santa Fe Railroad are within one mile of the station. The station is positioned on relatively flat ground at an elevation of 7310 feet, and is just east of the Continental Divide. The pipeline and transportation routes are located within a northwest trending drainage channel called Mitchell Draw. Several perennial and annual streams, some of which are derived from snowmelt, coalesce in Mitchell Draw.

TABLE 1 STORED LIQUIDS - TPC FACILITIES - EPA REGION 6

Station	Impoundment	Volume of Waste Liquid in Impoundment (bbl)	Tank Cap. (bbl)	Est. Tank Vol. (bbl)**
5 Thoreau	unlined	closed 1976-78	500	78
	concrete lined	0		
	concrete lined	unk*		
	unlined	unk*		
6 Laguna	concrete lined	unk*	500	50
7 Mountainair	unlined	closed 1984	500	81
	concrete lined	159		
	concrete lined	unk*		
	unlined	unk*		
	unlined	unk*		
8 Corona	unlined	closed 1983	500	100
	unlined	closed 1983		
	unlined	closed 1984		
Rio Grande	concrete lined	0	500	53

* Reported as not receiving pipeline fluids
** As of April 1985



Project No. 90158A	TPC	GENERAL LOCALITY MAP OF TRANSWESTERN STATIONS (5, 6, 7, & 8) IN NEW MEXICO	Figure 1
Woodward-Clyde Consultants			

The climate of the region is typical of high mountainous areas within the continental United States, and typically has long winters and shortened warming seasons. Snow is common and plentiful from mid-October to May and is accompanied by high winter temperatures of 30°F. Prevailing westerly winds of 10 to 20 miles per hour result in wind chill factors below 0°F during winter months. Annual rainfall of 12 inches or more is common. High rates of evaporation and transpiration are associated with peak summer months and extract a lot of moisture from shallow groundwater sources. Local soils support little vegetation, but the surrounding highlands have a large variety of conifers.

The occupations of local inhabitants include cattle and sheep ranching, as well as services associated with coal and gas production and the generation of electricity.

Situated within the eastern portion of the Colorado Plateau physiographic province, the site is boarded by the Zuni Mountains to the south and west, by the San Juan Basin to the north, and by the Ceboletta Mountains to the east. Geologically, the region contains the Upper Triassic Chinle Formation, Jurassic Todilto limestone, Upper Jurassic Thoreau Formation and Morrison Formation, which are capped with Quaternary alluvium. A generalized geologic cross section and stratigraphic column displaying these units is shown in Figure 2. Near the town of Thoreau, Harshbarger, Repenning, and Irwin (1957) identify and interpret the interval of Thoreau Formation as composed of Summerville Formation below and Cow Springs Formation above. The lower part of the Thoreau Formation is composed of alternating, poorly sorted, thin-bedded siltstone and sandstone, and is in gradational contact with the underlying Todilto Limestone (Smith, 1967). The lower beds of the Thoreau Formation grade upward into well-sorted, medium to fine-grained sandstone, and into sets of medium-grained, poorly sorted, cross-bedded sandstone toward the top of the sequence (Smith, 1967). The Morrison Formation rests disconformably on the Thoreau Formation and from base to top is composed of: sandy mudstone, conglomeritic sandstone, and medium to coarse-grained, poorly sorted quartz sandstone (Smith, 1967). The site specific soil conditions reported by TPC are described as "sandy" and probably represent the weathering of the sandstone bedrock.

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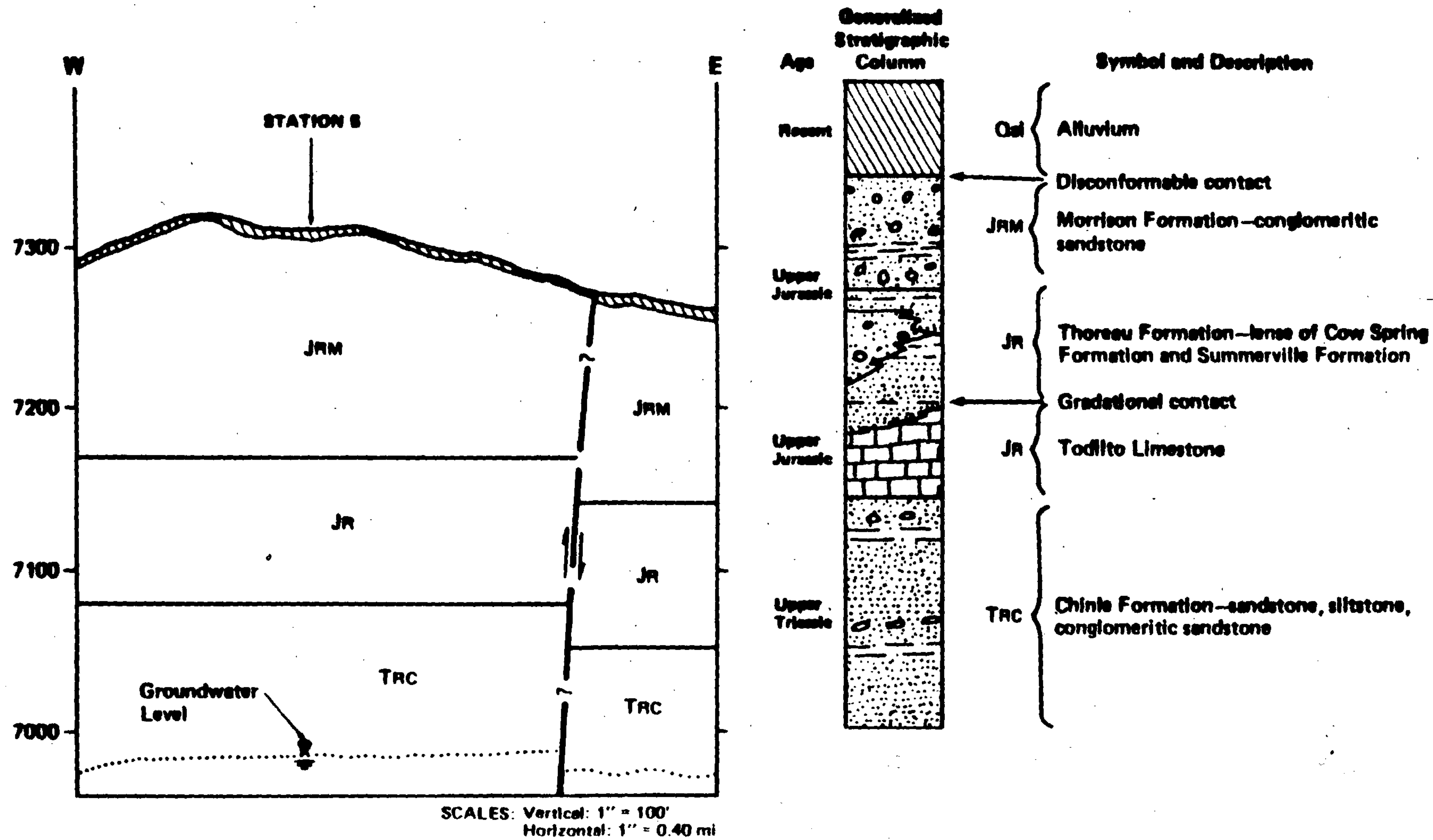
GENERALIZED GEOLOGIC CROSS SECTION AND DEPTH TO GROUNDWATER COMPRESSOR STATION 5

Figure 2



The region is transected by numerous north-to-northeast-trending high-angle normal faults and related shear zones. Typically, these structural discontinuities will act as no-flow or limited-flow barriers and may impound the groundwater. These structural features affect the ability of the rocks to contain water, yield water to wells, and largely control the availability, depth, and quality of water in the aquifers.

The principal aquifer westward from Grants to Gallup is the middle sandstone unit of the Triassic Chinle Formation (Cooper & West, 1967). The Chinle Formation underlies the floor of Mitchell Draw between Grants and Gallup, and the middle sandstone unit is a persistant aquifer which supplies nearly all of the groundwater used for stock, domestic, and industrial use (Cooper & West, 1967). According to Cooper and West, pumping rates of as much as 30 gpm are reported in these areas, but rates of 5 to 20 gpm are much more common and probably represent the maximum yield of most wells. Water in this aquifer is under confined conditions as a result of the dip of beds northwestward from the Zuni Mountains to the San Juan Basin. The artesian pressure is not great enough to allow flow upon the ground surface but does allow the water level to rise above the depth at which it is tapped in a well. This unit has its source of recharge in the Zuni Mountains and the direction of flow is down-dip into the San Juan Basin; however, in the valley near Thoreau the water moves southeastward, apparently in response to heavy withdrawals by pumpage in this region (Cooper & West, 1967). The chemical quality of water associated with the middle sandstone member of the Chinle Formation is of good to fair quality, but some is of poor quality (Cooper & West, 1967). According to Cooper & West (1967), the total differences in water quality are caused largely by differences in the clay content of the formation, by the ion-exchange capabilities within the formation, and by the movement and flushing action in the aquifer resulting from recharge by fresher water.

TPC reports that three water wells are associated with Compressor Station 5, and all are located within the southeast quarter of section 20, Township 14 North, Range 13 West. A summary of these wells is shown below:

Wells	Depth of Well (ft.)	Depth to Water table (ft.)	Water Quality	General Comments
1	746	402	Described by Transwestern	
2	1350	311	Pipeline as "Medium Hard"	Different Aquifer
3	735	402		

The principal utilization of groundwater is for public supply, industrial use, and irrigation. All motels, cafes, schools, and service stations are supplied by their own wells.

Shallow, unconfined groundwater sources associated with alluvial and fluvial deposits occur within the valley regions, at depths less than 50 feet. These sources of groundwater are highly dependent upon seasonal fluctuations, and as such are not a continually reliable source of water. The chemical quality of the water in the unconsolidated deposits ranges widely within short distances and varies within short periods of time because the source of recharge are numerous and may contribute water of different quality at different times.

Compressor Station 6, Laguna

TPC Station 6 is located about two miles southwest of Laguna, Valencia County, New Mexico (figure 1). Interstate Highway 40 and the Achison-Topeka-Santa Fe Railroad exist nearby and are the major transportation routes for the area. The station is bounded by the Ceboletta Mountains to the north, the Rio Grande depression to the east, and more locally numerous mesas. The Rio San Jose is an eastward flowing, effluent river, and is the major drainage basin in the area. The station is located on relatively flat ground at an elevation of 5930 feet.

The climate of the area is characterized by snow fall from October to March and temperatures which may reach the mid 40's (°F). Spring and summer months have temperatures into the 90's(°F) and tend to be quite arid. Prevailing winds from the west with velocities of 5 to 10 miles per hour and annual rainfall estimates of 15 inches are also typical of this area.

The primary occupations of local residents include sheep and cattle ranching, consumer services, and the mining industry. The mining industry in this area is no longer employing the volume of workers it once did. The closest neighbor to Compressor Station 6 is reportedly 3/4 -mile away.

The geology of the region is characterized by rocks that range in age from Pennsylvanian to Recent, but only the rocks that range in age from Late Triassic to Recent yield water to wells in the area (Dinwiddie and Motts, 1964). According to Shomaker (1967), stratified sedimentary sequences that range in age from Pennsylvanian to Cretaceous and Tertiary lava flows dominate the region. This region lies within the southeastern extremity of the Colorado Plateau physiographic province and also within the Laguna Mining District. The major structural feature in the area is McCarty's syncline, which plunges northward beneath the village of McCartys and the Mount Taylor volcanic field (Dinwiddie and Motts, 1964). According to Dinwiddie and Motts (1964) the regional dip of the stratified sedimentary sequences is north to northwest at low angles (about 2°); however, many minor faults and gentle folds influence the dips locally.

The site specific geology is dominated by Upper Jurassic sedimentary sequences and thick sequences of Quaternary alluvium. The Upper Jurassic sequences are the Todilto Limestone, Summerville Formation, Bluff Sandstone, and Morrison Formation. These units are dominately composed of siltstones, sandstones, claystones, and gypsum, with minor amounts of limestone and shale. A generalized geologic cross section and stratigraphic column in the vicinity of Station 6 is shown in Figure 3.

The alluvium is composed of fluvial and erosional deposits of gravel, sand, silt, and clay. The thickness of the alluvium is as much as 150 feet (Cooper & West, 1967), but the principal geomorphic process controlling the alluvial thickness are cut and fill cycles of the Rio San Jose. According to Cooper & West (1967), the alluvium north of the Rio

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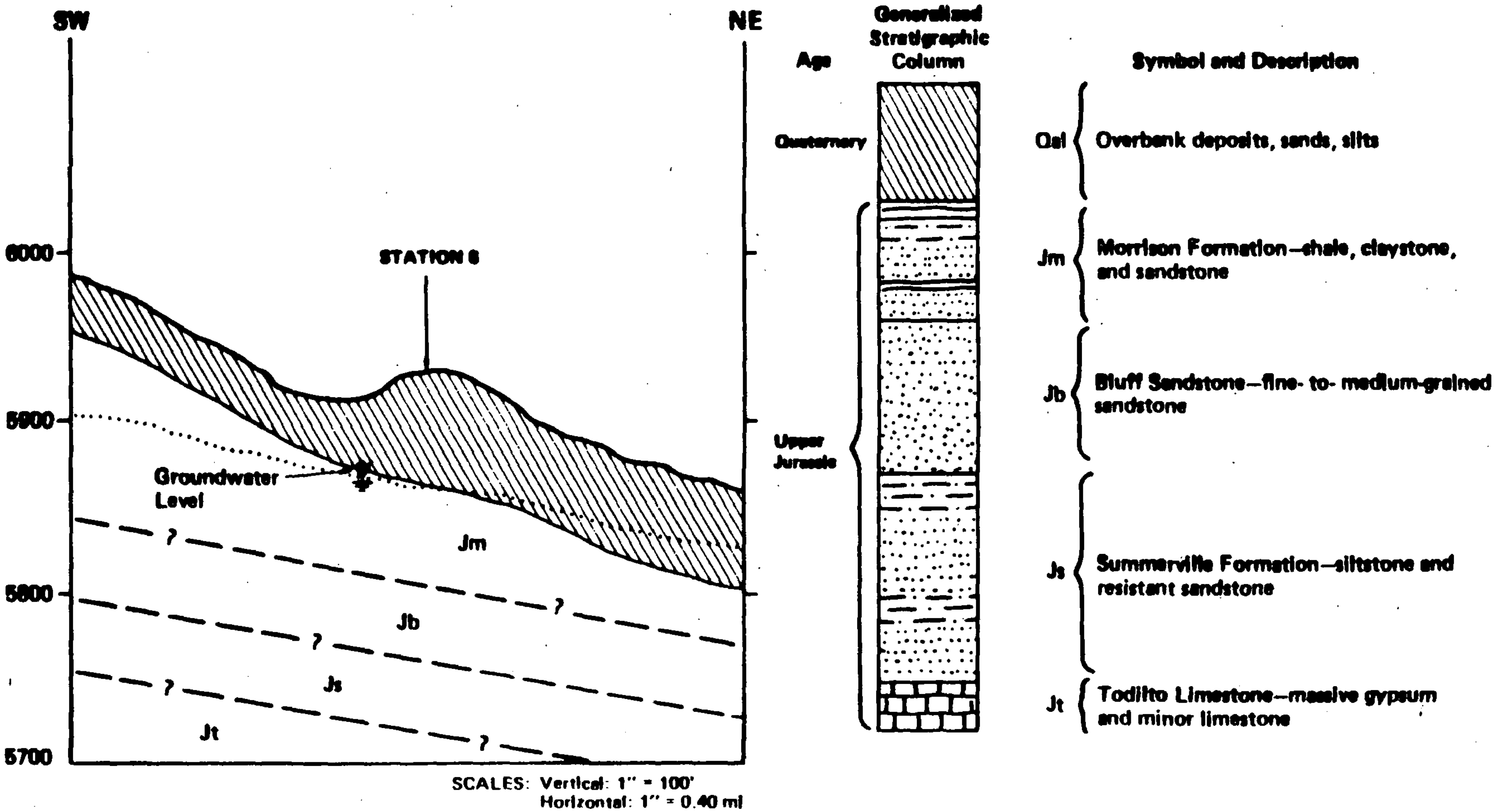
GENERALIZED GEOLOGIC CROSS SECTION AND DEPTH TO GROUNDWATER IN THE VICINITY OF COMPRESSOR STATION 6

Figure 3



San Jose contains coarser and better sorted sediments than does the alluvium south of the river, which is finer-grained and poorly sorted. The difference of the alluvium is due to different source materials. the north side of the Rio San Jose obtains material from volcanic and sedimentary sources, while the south side derives material from sandstone and shale. As a result, water wells associated with the low permeability (south side) alluvium yields water to wells much more slowly.

According to Cooper and West (1967), the aquifer which supplies the greatest volume of water to local residents is the unconsolidated alluvium along the Rio San Jose.

The yield of wells that tap the alluvium range from 2 to more than 150 gpm, and the larger-capacity wells obtain water from discontinuous lenses of channel gravel deposits which are interbedded with flood-plain silt deposits (Cooper & West, 1967).

Water in the fine-grained alluvium south of the Rio San Jose is more highly mineralized than water in the coarse-grained alluvium north of the Rio San Jose because the fine-grained alluvium contains a greater proportion of readily soluble minerals (Dinwiddie and Motts, 1964). According to Dinwiddie and Motts (1964), the coefficient of transmissibility of the alluvium ranges from 560 to 130,000 gpd (gallon per day) per foot. The quality of water derived from the alluvial aquifer has concentrations of dissolved solids ranging from 375 to 8,440 ppm (parts per million), concentrations of sulfate from 53 to 4020 ppm, and elevated fluoride, and chloride concentrations (Dinwiddie and Motts, 1964). In general, water in the alluvium north of the Rio San Jose is generally less mineralized than that south of the river.

Transwestern Pipeline Company (TPC) reports only one water well at this station which has a high sedimentation rate and is described as "hard". As a result, water is imported on a once a week basis in winter, and every other day basis during the summer.

The depth to groundwater is a function of seasonal variations but generally should not exceed 25 feet in the vicinity of Compressor Station 6. The general direction of groundwater flow is toward the Rio San Jose to the north and northeast.

Compressor Station 7

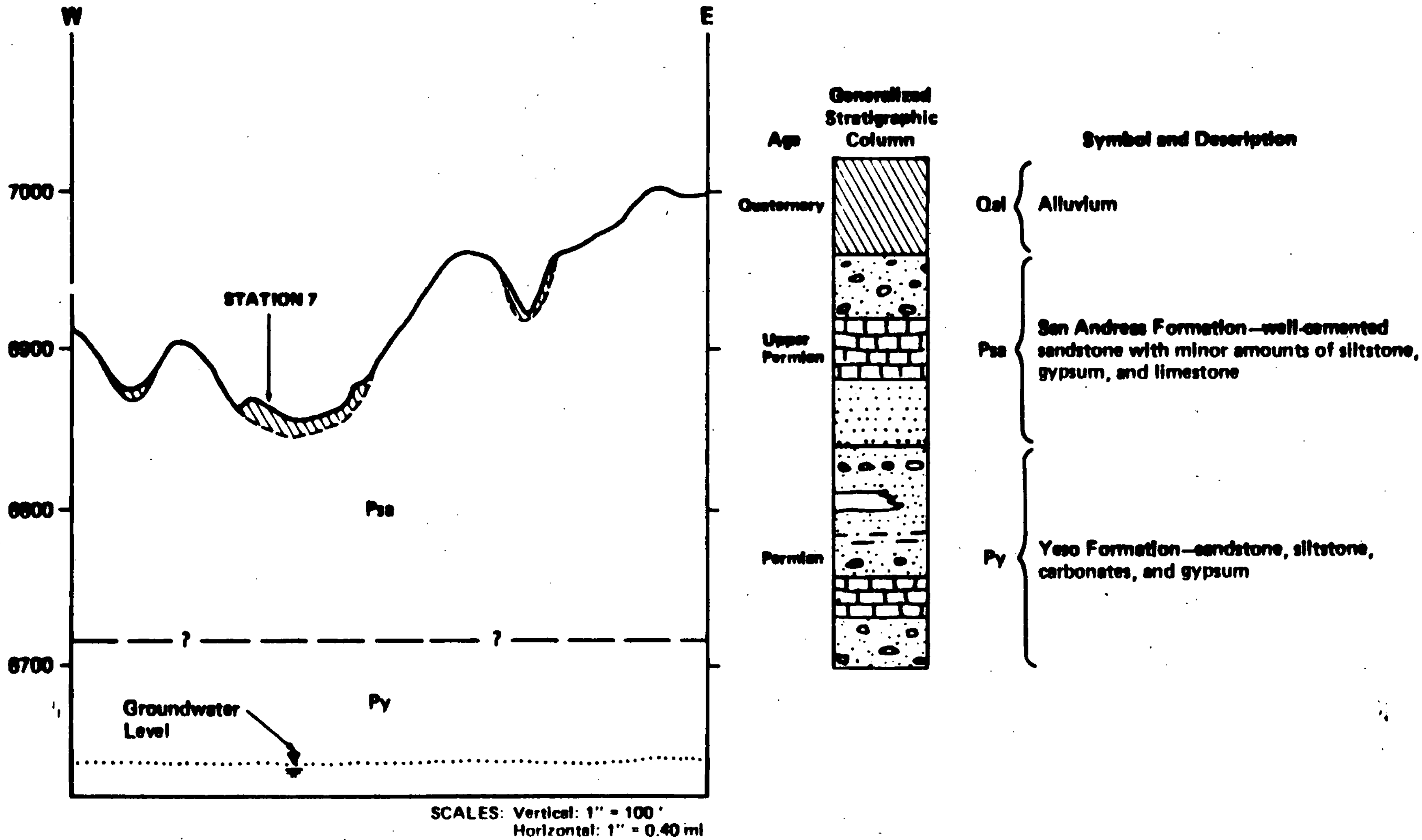
TPC Compressor Station 7 is located southeast of Albuquerque, Torrance County, New Mexico (Fig. 1). It is approximately 11 miles from U.S. Highway 60 and 24 miles to the closest town. The region is bounded by the Los Pinos and Monzano Mountains to the west, Estancia Valley to he north, Pederna Hills to the east, and Chupadera Mesa to the south. The site elevation is 6860 feet and is located on rolling hills.

The climate of the area is semiarid. Although extreme temperatures in this area range from -20°F to almost 100°F, the average winter temperature is in the 20's°F, and the average summer temperature range from the high 60's°F to low 70's°F. Snowfall can be expected from late September to May, and annual rainfall estimates of 13^{+} inches is typical. Wind velocities of 5 to 15 miles per hour are common and in peak winter months result in wind chill factors below 0°F. Annual, potential evaporation rates up to 60 inches are typical of this environment (Smith, 1959).

The principal occupations of local inhabitants are raising livestock and farming. The livestock ranches are engaged in cattle, sheep, and chicken production. Farming products include seedbeans (mostly pinto beans), corn, sorghum, and wheat.

Located within the eastern limits of the Basin and Range physiographic province, the site is east of the Rio Grande Trough and boarders on the Great Plains physiographic province. The geology of the area is dominated by the Permian age Yeso Formation, the Upper Permian San Andreas Formation, and Quaternary alluvium (Smith, 1957). According to Smith (1957) the Permian formations are composed of well-cemented sandstones, limestones, siltstone, and gypsum, while the volcanic rocks are diorite and diabase dikes and sills. A generalized geologic cross section and stratigraphic column are shown on Figure 4. The Yeso Formation crops out in a general east to west band along the escarpment of Chupadera Mesa and is the principal aquifer in this area (Smith, 1957). Under favorable conditions, the Yeso Formation furnishes larger quantities of water from its limestone member, which contains cavities and solution channels (Smith, 1957). Locally, the Yeso Formation is highly fractured and wells associated with these fracture systems significantly produce greater yields. The movement of groundwater beneath Chupadera Mesa is southward and the depth to water may exceed 500 feet (Smith, 1957). Smith (1957) describes the quality of groundwater derived from the Yeso Formation as generally unsatisfactory for domestic use and irrigation, while satisfactory for livestock. The primary source for degradation of water quality is due to the presence of gypsum interbeds which liberate sulfates, calcium, and chloride elements into the aqueous environment.

The San Andreas Formation is divided into a basal sandstone member, middle limestone member, and upper fine-grained clastic member (Smith, 1957). The basal sandstone member lies conformably on the Yeso Formation and is exposed along the escarpment of Chupadera Mesa. This basal sandstone member of the San Andreas Formation is the principal aquifer over about 130 square miles of Torrance County (Smith, 1957). Movement of groundwater associated with this member is southward and is reported as having variable quality (Smith, 1957). The middle limestone member of the San Andreas Formation forms the surface of Chupadera Mesa and is riddled with numerous solution channels and pits. This limestone member of the San Andreas Formation in Torrance County is every where above the unconfined water level, and no wells are known to derive water from it (Smith, 1957). Impoundments of surface fluids and precipitation can infiltrate into this porous medium and recharge underlying aquifers. The upper clastic member of the San Andreas Formation has apparently been eroded from Chupadera Mesa and is only present as collapsed blocks in sink holes (Smith, 1957).



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GENERALIZED GEOLOGIC CROSS SECTION AND DEPTH TO GROUNDWATER IN THE VICINITY OF COMPRESSOR STATION 7

Figure 4

The periphery of Chupadera Mesa is blanketed with erosional debris and local drainages contain a variety of fluvial deposits. This alluvium will act as shallow water bearing and recharge zones during periods of rainfall and snowmelt. Typically, this material is not an important source of potable water and will be greatly influenced by seasonal variations.

Structurally, Chupadera Mesa is a broad, very shallow syncline in which rocks of the Yeso Formation and San Andreas Formation dip very gently to the south east (Smith, 1957). Chupadera Mesa rises up sharply against Estancia Valley to the north. Estancia Valley is a broad, closed structural basin, bounded by fault blocks mountains and contains very thick sequences of valley fill material. The Yeso Formation is the principal aquifer in parts of Estancia Valley (Smith, 1957), however the thick sequences of alluvial deposits also store large quantities of groundwater. The chemical quality of groundwater derived from Tertiary and Quaternary valley fill differs considerably with locality. In general, as the groundwater moves from the valley periphery toward its center, the mineral content becomes progressively greater (Smith, 1975). Water levels range from at or near the surface, in the central part of the valley, to more than 100 feet below the surface, in the irrigation wells near the west edge of the valley, and to more than 200 feet below the surface in the livestock and domestic wells near the eastern edge (Smith, 1975).

Near the north end of Chupadera Mesa and north of Station 7, an east-west groundwater divide exists separating groundwater moving northward toward Estancia Valley from that moving southward (Smith, 1975). Wells on Chupadera Mesa in Torrance County range in depth from more than 250 feet in the northeast part to 970 feet in the southwestern part, with most wells being deeper than 450 feet (Smith, 1957). According to Smith (1957), chemical analysis of groundwater from wells on Chupadera Mesa indicate that it is suitable for stock, but it is not desirable for domestic use. In general, the water is very hard (> 250 mg/ℓ CatMg) and has elevated levels of sulfate, magnesium, and fluoride (Smith, 1957).

Transwestern Pipeline Company reports that two water wells located within Township 1 North, Range 8 East of Section 28 have depths greater than 600 feet. No depth to water or water quality analysis are known.

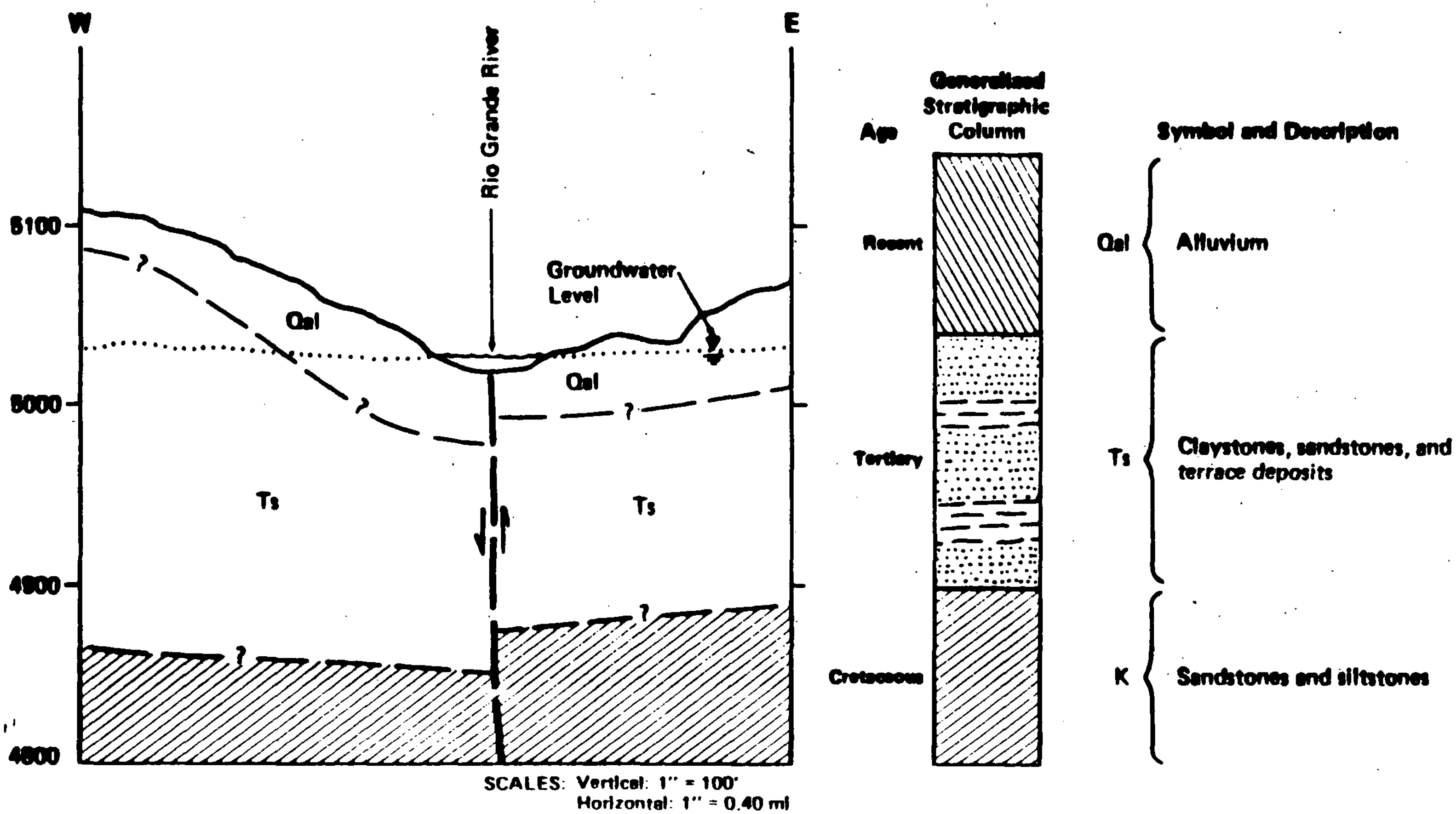
Rio Grande River Crossing Near Belen

Transwestern Pipeline Company's natural gas transmission line crosses the Rio Grande River south of Belen, New Mexico. This area is located within the central portion of the Albuquerque Basin of central New Mexico. The basin proper is bounded by several structural benches to the east and west. The term, Rio Grande trough, is used for the tectonics of the linear depression and includes the main alignment of grabens and adjoining uplifts that are an extension of the Rocky Mountains.

The basin is filled with Quaternary sediments composed of unconsolidated to partially-consolidated claystone and sandstones. These sediments overlie extensive sequences of Cretaceous and Tertiary rock (Kelley, 1977). All of the stratigraphic sections are dissected by numerous north-to-northeast-trending structural discontinuities. A generalized geologic cross-section and stratigraphic column is shown in Figure 5.

The Rio Grande River is flanked by extensive flood plain deposits which attain a width of up to two miles near the town of Belen. Relief on the flood plain is generally no more than 5 to 10 feet, excluding artificial levees and other man-made structures (Kelley, 1977). Associated with the flood-plain deposits are numerous terraces formed along the sides of the Rio Grande.

Average annual precipitation rates of 8 to 12 inches per year and evapotranspiration rates of 60+ inches per year are typical for this area. The average annual temperature for the region is about 55°F, although seasonal variations of 100°F in summer and 30°F in winter are common.



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GENERALIZED GEOLOGIC CROSS SECTION AND DEPTH TO GROUNDWATER NEAR BELEN

Figure 5

The geology of the region is a critical factor in the occurrence of groundwater, because the type, extent, thickness, and attitude of the rocks determine, to a great extent, the yield and quality of water at a particular site. In addition, structural controls in this area are the principal factor governing groundwater flow. The hydrogeology of the Rio Grande Valley is complex and flow occurs in a system of downfaulted blocks throughout its entire course (Kelley, 1977). A vast quantity of potable water exists in the alluvium of the Rio Grande Valley. Large yields of water are obtained from the alluvium, and beneath the river's flood plain the depth to water is about equivalent to the difference in elevation between the land surface on the slopes and on the flood plain (Kelley, 1977).

According to Kelley, the lowest part of the water table in the vicinity of Belen is not along the river but several miles west of the river. At places along this depression, the depth to water is as much as 50 feet below the river level. The development of groundwater resources adjacent to the river has diminished in flow to the river, and over time may result in the loss of waters from the river to adjacent groundwater reservoirs.

The principal uses of groundwater in this area are for agriculture, light industry, and domestic purposes. The quality of groundwater is generally quite good, although intensive agricultural practices in the Rio Grande Basin have resulted in increased levels of salinity, nitrogen-containing fertilizers, pesticides, and herbacides (Kelley, 1977).

<u>Compressor Station 8</u>

TPC Compressor Station 8 is located in a remote portion of Lincoln County, New Mexico (Figure 1). North and northeast of Lincoln National Forest, the site is located on rolling hills supporting sparse vegetation. The site is bounded by the Captain Mountains to the south, the Jicarilla Mountains to the west, and is adjacent to Little Hasparos Canyon. This region is dissected by numerous, annual stream channels which flow to the east.

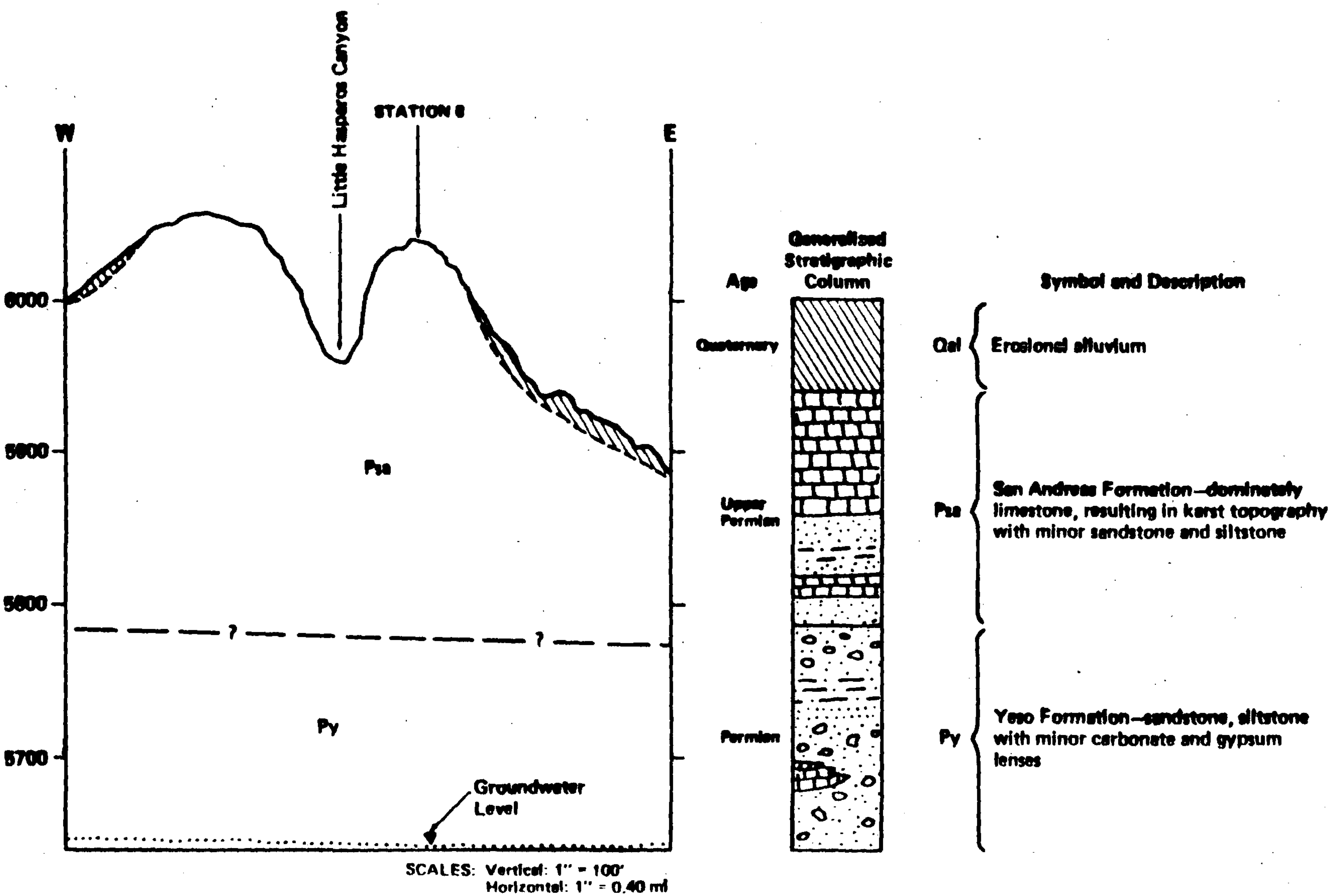
Located at an elevation of 5800 feet, snowfall is common from October to April. This station is snow-bound several times each year for periods of three to seven days. Wind velocities on the order of 35 miles per hour are common and result in wind chill factors below 0°F. Average annual rainfall estimates of 15 or more inches are typical.

This remote sight has it's nearest neighbor three miles away, while the next closet neighbor is 15 miles away, and the nearest town is 38 miles away. Interstate Highway 54 is the closest major transportation route and is located approximately 20 miles west of the station.

Situated within the Great Plains physiographic province, the geology of the region is characterized by Permian age sedimentary sequences and Quaternary alluvium (Dane and Bachman, 1965). More specially, Station 8 is underlain by alluvial cover, the San Andreas Formation, and Yeso Formation. The San Andreas Formation is primarily composed of dominately carbonates with subordinate amounts of siltstone, sandstone, and gypsum. The weathering of the carbonates result in Karst topography which is very typical of the region. The Yeso Formation is primarily composed of sandstone and siltstone, with minor amounts of carbonate interbeds. A generalized geologic cross section and stratigraphic column is shown in Figure 6. The structural trend of these geologic units is shallow dipping to the east.

TPC reports that two water wells are associated with this station. The original well is located in Township 5 South, Range 15 East, of section 13 and is 424.5 feet deep, with depth to groundwater at 379.5 feet. Very low flow conditions at this well required the installation of a second well. The second well is located approximately three miles from the station and is 150 feet deep.

Water quality of the second well is described by TPC as very hard and requires that vinegar be used when washing laundry and dishes. The amount of calcium, magnesium, and iron contribute to the hardness of the



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GENERALIZED GEOLOGIC CROSS SECTION AND DEPTH TO GROUNDWATER IN THE VICINITY OF COMPRESSOR STATION 8

Figure 6

water. These cations will react with soap to form a precipitate, thus reducing the cleansing action of the soap. The addition of vinegar which contains a mild acid known as acetic acid will hold the cations in solution and increase the cleansing action of the soap. The gypseous component of the Yeso Formation will tend to liberate sulphate, chloride, and calcium elements, which tend to degrade water quantity. The solution of calcium carbonate by water causes prevailing hard groundwater to be found in limestone bearing aquifers.

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